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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of

Takayuki KIFUKU

Appln. No.: 09/286,418

Confirmation No.: 4951

Filed: April 06, 1999

For: ELECTRIC POWER STEERING SYSTEM

Docket No: Q53818

Group Art Unit: 3661

Examiner: Brian J. BROADHEAD

SUBMISSION OF APPELLANT'S BRIEF ON APPEAL

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Submitted herewith please find an original and two copies of Appellant's Brief on Appeal. A check for the statutory fee of $330.00 is attached. The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account. A duplicate copy of this paper is attached.

Respectfully submitted,

Cameron W. Beddard
Registration No. 46,545

SUGHRUE MION, PLLC
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

WASHINGTON OFFICE
23373
CUSTOMER NUMBER

Date: September 9, 2004

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APPELLANT'S BRIEF ON APPEAL UNDER 37 C.F.R. § 1.192

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Sir:

In accordance with the provisions of 37 C.F.R. § 1.192, Appellant submits the following:

I. REAL PARTY IN INTEREST

The real party in interest is MITSUBISHI DENKI KABUSHIKI KAISHA, by virtue of an assignment executed by Takayuki Kifuku (Appellant, hereafter) on March 19, 1999, and recorded by the Assignment Branch of the U.S. Patent and Trademark Office on April 6, 1999, at Reel 9889, Frame 0516.

II. RELATED APPEALS AND INTERFERENCES

To the knowledge and belief of Appellant, the Assignee, and the undersigned, there are no other appeals or interferences before the Board of Appeals and Interferences that will directly affect or be affected by the Board's decision in the instant Appeal.

III. STATUS OF CLAIMS

Claims 1, 2, and 4-20 are all the claims pending in the application. Claims 1, 2, 4, 5, 8-10 and 18-20 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Kifuku et al. (US 5,740,040). Claims 6, 7 and 11-17 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The appealed claims are claims 1, 2, 4, 5, 8-10 and 18-20.

IV. STATUS OF AMENDMENTS

All amendments have been entered.

V. SUMMARY OF THE INVENTION

The present invention relates to an electric power steering system for assisting steering force with a motor. FIG. 1 is a diagram showing an electric power steering system according to an illustrative embodiment of the present invention. The electric power steering system of FIG. 1 includes a motor 1, a steering wheel 11, a steering shaft 12 connected to the steering wheel 11, a car speed sensor 13 for detecting the speed of an automobile by detecting the rotation of a

transmission (not shown), a torque sensor 14 connected to the steering shaft 12 for detecting the steering torque of a driver, a motor reduction gear 15 for transmitting the output torque of the motor 1 to the steering shaft 12, a controller 16 for driving and controlling the motor 1 based on signals from the car speed sensor 13, the torque sensor 14 and the like, and a battery 17 as a power source for the controller 16. See page 11, lines 4-18, of the present specification.

FIG. 3 is a diagram showing an illustrative embodiment of the software stored in a ROM 31 (FIG. 2) used for steering control, and FIG. 4 is a flow chart for explaining the operation of the software. FIG. 3 includes a motor 1, motor angular velocity computing means 2, motor angular acceleration computing means 3, coulomb friction compensation current computing means 4, viscous friction compensation current computing means 5, inertia compensation current computing means 6, steering force assist current computing means 7, and current control means 8. Reference numeral 9 represents the static friction computing means for computing an estimated value Tf of static friction of the steering system from a steering torque Vt from the torque sensor 14 (Step S5 in FIG. 4). Reference numeral 10 represents static friction compensation current computing means for computing a static friction compensation current If for compensating for the static friction of the steering system based on a static friction estimated value Tf from the static friction computing means 9 and a car speed Vs obtained from the output of the car speed sensor 13 (Step S10 in FIG. 4). See page 12, lines 14-32; page 13, lines 30-34; and page 15, lines 1-6.

VI. ISSUES

The sole issue on appeal is whether claims 1, 2, 4, 5, 8-10 and 18-20 are properly rejected under 35 U.S.C. § 102(b) as being anticipated by Kifuku et al.

VII. GROUPING OF CLAIMS

For the purposes of the present appeal, the rejected claims do not stand or fall together. Specifically, the rejected claims are divided into the following separately patentable groups.

Group 1: Claims 1, 4, 5, 18, 19 and 20

Group 2: Claims 2 and 8

Group 3: Claims 9 and 10

The Arguments section below provides arguments in support of the separate patentability of the groups, beginning on the following pages: Group 2, page 9; Group 3, page 9.

VIII. ARGUMENTS

Appellant respectfully submits that the claims are not anticipated by Kifuku et al.

Group 1

Group 1 includes claims 1, 5, 18, 19 and 20. Claim 1 is independent, and claims 5 and 18 depend from claim 1. Claims 19 and 20 depend from claim 18.

Group 1, Argument: Kifuku et al. fails to teach or suggest a means of computing an estimated value of static friction of the steering system based on the steering force of a driver.

Independent claim 1 requires "a means of computing an estimated value of static friction of the steering system based on the steering force of a driver." In the Response under 37 C.F.R. § 1.111 filed November 23, 2003, Appellant argued that Kifuku et al. fails to disclose this feature of the claims. In the "Response to Arguments" on page 4 of the Office Action dated February 11, 2004, the Examiner argues that the last paragraph on page 17 of the Applicant's specification discloses that the angular velocity can be used to detect the static friction. The Examiner contends that static friction is force and thus the configuration disclosed on page 17 falls under the definition of a torque sensor. Further, the Examiner asserts that the Kifuku et al. reference discloses the same configuration. Appellant respectfully disagrees.

The paragraph on page 17 of Appellant's specification cited by the Examiner discloses that in an embodiment of Appellant's invention, the static friction of the steering system is estimated by extracting the edge of the angular velocity of the steering system. However, this embodiment is not what is claimed in claim 1 of the present invention. Rather, claim 1 recites a means of computing an estimated value of static friction of the steering system **based on the steering force of a driver**. To anticipate claim 1, Kifuku et al. must disclose that which is claimed, which is a means of computing an estimated value of static friction of the steering system **based on the steering force of a driver**. Kifuku et al. does not include such a disclosure.

Furthermore, as previously described in the Response filed November 26, 2003, in an exemplary embodiment of the present invention shown in FIG. 3, the static friction compensation current computing means 10 is independent from the motor angular velocity

computation means 2 and the motor angular acceleration computation means 3, and thus independent of the motor angular velocity itself.

The Examiner cites col. 20, lines 35-40 of the reference as allegedly disclosing the claimed means of computing an estimated value of static friction of the steering system based on the steering force of a driver. However, the cited portion of the reference actually discloses the following:

> *In the present invention, the static friction cannot be completely compensated because no means for detecting the steering angle is provided, but if static-friction compensating current is arranged to be calculated depending on the differential value of the motor angular velocity estimate ω, the effect of static friction can be alleviated.*
>
> *FIG. 31 is a block diagram representation of static friction compensation in this embodiment.*

Clearly, this excerpt does not disclose a means of computing an estimated value of static friction of the steering system based on the steering force of a driver. Instead, as described in the excerpt and shown in FIG. 31, the motor angular velocity estimate ω is used to calculate static-friction compensating current.

FIG. 31 of the reference, as well as the specification at column 20, lines 34-39, which describes the static friction compensation in the reference, clearly shows a static-friction compensating current calculation means 20 for compensating the static friction, based on an estimate that uses vehicle speed Vs and a differentiated value of motor angular velocity ω as inputs, to produce a static-friction compensating current target If. In other words, Kifuku et al. teach deriving a steering assist current target value Is based on a differentiated value of motor

angular velocity and the vehicle speed Vs. Kifuku et al. does not teach or suggest a means for determining the static friction of the steering system based on the driver's steering force (steering torque Vt). Conversely, the static friction compensation current computing means 10 of the present invention estimates the value of static friction of the steering system independently of the motor angular velocity ω, and is accordingly not similar to Kifuku's calculation means 20.

The steering assist current calculation means 9 of Kifuku et al. (FIG. 2; col. 2, lines 12-20) calculates a steering assist current I_s based on the vehicle speed V_s and the steering torque V_t. This calculation means 9 corresponds in principle to the steering force assist current computing means 7 of Applicant's exemplary embodiment shown in FIG. 3. The steering assist current calculation means 9 of Kifuku et al. is distinct from the static friction compensating current calculation means 10 of Appellant's FIG. 3. The static friction computation means of claim 1 of the present invention obtains an estimated value of the static friction of the steering system based on the driver's steering force (steering torque, Vt). Thus, the static friction computation means of claim 1 of the present invention is distinct from both the steering force assist current computing means 7 of the present invention and the steering assist current calculation means 9 of Kifuku et al.

In reply to the Response under 37 C.F.R. § 1.116 filed May 10, 2004, the Examiner states that the Response has been considered but does not overcome the rejection, because

> *angular velocity of the steering system is a measure of steering force of a driver as disclosed in the applicant's disclosure in the last paragraph on page 17, and in paragraph 4 on page 23. On page 23, in paragraph 4, applicant discloses that in embodiment 2 the static friction is calculated by extracting the edge of the*

> *steering force detection value. Embodiment 2 only has an angular velocity sensor and not a torque sensor so the steering force of the driver is being measured by the angular velocity. From this disclosure by the applicant the limitation of "based on a steering force of a driver" in claim 1 is interpreted to encompass using an angular velocity measurement as a representation of steering force of a driver.* Continuation Sheet of Advisory Action dated June 9, 2004.

However, the Examiner's assertion regarding the Appellant's disclosure is incorrect. The Appellant's specification in the last paragraph on page 17 discloses the following.

> *In the above Embodiment 1, the static friction of the steering system is estimated by extracting the edge of the steering torque detection value Vf. The same effect can be obtained by extracting the edge of the angular velocity of the steering system. The angular velocity may be motor angular velocity ω, back electromotive force Ve, steering speed or the like. In this Embodiment 2, the static friction of the steering system is estimated by extracting the edge of the angular velocity of the steering system. Therefore, the static friction can be estimated without being influenced by the noise of the torque sensor 14.*

In other words, the static friction of the steering system can be estimated by extracting the edge of the steering torque detection value (Embodiment 1) or by extracting the edge of the angular velocity of the steering system (Embodiment 2). That is, the disclosure describes two distinct and different ways to estimate the static friction of the steering system. However, contrary to the Examiner's assertion, this disclosure does not state that the angular velocity is a measure of the steering force of a driver.

Thus, claim 1 is not anticipated by Kifuku et al. for at least these reasons.

Therefore, Appellant respectfully requests the reversal of the rejection of the claims of Group 1, for at least the aforementioned reasons.

Group 2

Group 2 includes claims 2 and 8. Claim 2 depends from claim 1, and claim 8 depends from claim 2.

Group 2, Argument: Kifuku et al. does not teach or suggest the static friction of the steering system being estimated by extracting the edge of the steering force detection value.

The Examiner asserts that Kifuku et al. discloses the limitations of claim 2 at col. 20, lines 45-46, but Appellant disagrees. Col. 20, lines 45-46 of Kifuku et al. discloses that the differential calculation means 19 differentiates the motor angular velocity estimate ω and extracts the rising edge ω_{edg}. Thus, the excerpt of Kifuku et al. referred to by the Examiner discusses only a motor angular velocity estimate and does not state anything about estimating the static friction of the steering system by extracting the edge of the steering force detection value.

Appellant respectfully requests the reversal of the rejection of the claims of Group 2, for at least the reasons noted with respect to claim 2 and the reasons noted above with respect to Group 1.

Group 3

Group 3 includes claims 9 and 10. Claim 9 depends from claim 1, and claim 10 depends from claim 9.

Group 3, Argument: Kifuku et al. does not teach or suggest the static friction compensation having a term proportional to the static friction estimated value obtained by the positive feedback of the static friction estimated value.

According to claim 9, the static friction of the steering system is compensated by a static friction compensation having a term proportional to the static friction estimated value. An example of such a proportional term is the first term in equation 4 on page 15 of the present application. In contrast, Kifuku et al. discloses using ω_{edg} and the vehicle speed V_s in accordance with a look up table of static friction compensating current values, to determine the compensating current target I_c. See col. 20, lines 46-52. As shown in Figure 33, the resulting compensating current target I_c has only certain constant values, and does not have a term proportional to a static friction estimated value.

Appellant respectfully requests the reversal of the rejection of the claims of Group 3, for at least the reasons noted with respect to claim 9 and the reasons noted above with respect to Group 1.

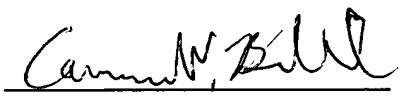
IX. CONCLUSION

Appellant respectfully requests the members of the Board to reverse the rejection of all appealed claims and to find each of the claims allowable as defining subject matter which is patentable over the applied reference.

The present Brief on Appeal is being filed in triplicate. Unless a check is submitted herewith for the fee required under 37 C.F.R. §1.192(a) and 1.17(c), please charge said fee to Deposit Account No. 19-4880.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



Cameron W. Beddard
Registration No. 46,545

SUGHRUE MION, PLLC
Telephone: (202) 293-7060
Facsimile: (202) 293-7860
WASHINGTON OFFICE

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CUSTOMER NUMBER

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APPENDIX

CLAIMS 1, 2, 4, 5, 8-10 and 18-20 ON APPEAL:

1. An electric power steering system for driving a motor connected to a steering system based on a steering force detection value obtained by detecting the steering force of a driver to assist the steering force of the steering system, the system comprising:

a means of computing an estimated value of static friction of the steering system based on the steering force of a driver; and

a means of compensating for the static friction based on this estimated value of static friction.

2. The electric power steering system of claim 1, wherein the static friction of the steering system is estimated by extracting the edge of the steering force detection value.

4. The electric power steering system of claim 1, wherein the static friction of the steering system is estimated by extracting the edge of a motor current.

5. The electric power steering system of claim 1, wherein the static friction of the steering system is estimated by extracting an edge of the steering force detection value, the motor angular velocity, the motor back electromotive force, the steering angular velocity or the motor current, wherein the extraction of the edge is carried out through a high frequency pass filter.

8. The electric power steering system of claim 2, wherein an upper limit is provided for the static friction estimated value.

9. The electric power steering system of claim 1, wherein static friction compensation

having a term proportional to the static friction estimated value obtained by the positive feedback of the static friction estimated value is computed and the static friction of the steering system is compensated by the static friction compensation.

10. The electric power steering system of claim 9, wherein the gain of the positive feedback is set such that the static friction estimated value and the motor output torque become almost equal to each other.

18. The electric power steering system of claim 1, wherein the dynamic friction or inertia of the steering system is compensated based on the angular velocity or angular acceleration of the motor or steering.

19. The electric power steering system of claim 18, wherein a term for compensating for dynamic friction and a term for compensating for static friction are weighed so that one of them is used.

20. The electric power steering system of claim 18, wherein the term for compensating for dynamic friction, the term proportional to the static friction estimated value and the term for compensating for the nonlinearity of the motor or the motor reduction gear are weighed so that at least one of them is used.